Delta Vision

Context Memorandum: Demand Management (Water Efficiency)

This context memorandum provides critical information about demand management (water efficiency) to support policy making. As they are developed, the context memos will create a common understanding and language about the critical factors in establishing a Delta Vision.

This is an iterative process and this document represents the beginning of a dialogue with you about how best to understand demand management and to inform recommendations by the Delta Vision Blue Ribbon Task Force. You have two weeks to submit comments that may be incorporated into the next iteration.

You may submit your comments in two ways: either online at dv_context@calwater.ca.gov or by mail. If you are using mail, please send your comments to: Delta Vision Context Memo: Demand Management, 650 Capitol Mall, 5th Floor, Sacramento, CA 95814.

Your attributed comment will be posted on the Delta Vision web site (http:www.deltavision.ca.gov). Please cite page and line number with specific comments; general comments may be keyed to sections.

Your participation in this iterative process is valuable and important and is greatly appreciated. Thank you for your comments.

Context Memorandum: Demand Management (Water Efficiency)

Iteration 2: July 9, 2007

Section 1. Background

The purpose of this memo is to describe how water use efficiency connects with sustainable management of the Delta. The construct of this memo assumes that the reader is aware of the other major components of a water management strategy including: groundwater and conjunctive use options, surface storage, recycling and desalination.

> In the early years of water resource development the phrase **water conservation** referred to the construction of dams and impoundments to store water for later use.
>
> **Water use efficiency** refers to the amount of water required to meet an objective. The less water that is required to meet the objective the higher the efficiency. For example, a concrete lined canal would have a higher efficiency than a canal with a sandy soil. A water use efficiency action can conserve water.
>
> From the California water code: **Demand management**, means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

Although water use efficiency is acknowledged in the Water Supply and Quality context memo, additional information is deemed necessary because of its role in the relationship between water supply and demand

Section 2. Delta Policy Connection

Water use efficiency is an option that is available to regional and local agencies in their management of water supplies and demands. The Water Supply and Water Quality Context Memo states that water demand in the Delta is about 6% of the State's developed water supplies. Therefore, compared to the state as a whole, the in-Delta connection for water use efficiency is relatively small.

Outside of the Delta there is significant potential for gains from implementing water use efficiency actions. The 2006 Comprehensive Evaluation of the CALFED Water Use Efficiency Program Element found that, depending on the level of investment and other policies, the analysis projects between 1,400,000 and 3,100,000 acre-feet of savings by 2030. A full description of this analysis is presented in Section 5 of this memo.

> The Irvine Ranch Water District's conservation program is an example of one way a local supplier incorporates the costs of water efficiency actions into their rate structure. Their water efficiency actions are funded by penalty revenues in its water rate structure. A customer using more than their water budget pays a progressively higher penalty through a tiered rate structure for the amount used over the budget. Revenues from the penalties are dedicated to the water conservation program, recycling and run-off control.

The potential benefits of known water use efficiency actions are well characterized and are a recognized component of a diversified water management strategy that includes; ground and surface storage, recycling, and desalination. Water use efficiency actions can be used to minimize uncertainty, increase reliability and meet the challenge of future droughts and climate change.

The CALFED Record of Decision stated that the advantages of water use efficiency investments are that they can yield real water supply benefits to urban and agricultural users in the short term, especially compared to surface storage and major conveyance improvements that will take at least 5 to 10 years to complete; and (b) water use efficiency investments can generate significant benefits in water quality and timing of in-stream flows, even where they may not generate a net increase in available consumptively used water. Water reclamation provides additional opportunities to reduce water demand in a relatively cost-effective and environmentally-benign manner, with multiple benefits for efficiency, dry year reliability and discharge water quality.

Policy questions that the Delta Vision Task Force should be aware of include:

- What is the State's role in regulating the implementation of water use efficiency actions at the regional and local level?
- Considering costs, benefits, and tradeoffs among water management strategies what is the appropriate level of water use efficiency at the local and regional level?
- Considering costs, benefits, and tradeoffs among water management strategies what is the appropriate level of Bay-Delta supplies that should be available to local and regional agencies?

Section 3. Setting the Context

Figure 1 shows that the implementation of water use efficiency actions is based on the nature of demands, the availability of different water sources, the economics of using a water source and the quality of the water. It should be noted that nearly all major water suppliers in the state, or their end users, rely on more than one water source including groundwater, local surface water, recycled water and imported surface water.

Context Memorandum: Demand Management (Water Efficiency)

Iteration 2: July 9, 2007

Conceptual model of linkages between water supply and water use efficiency

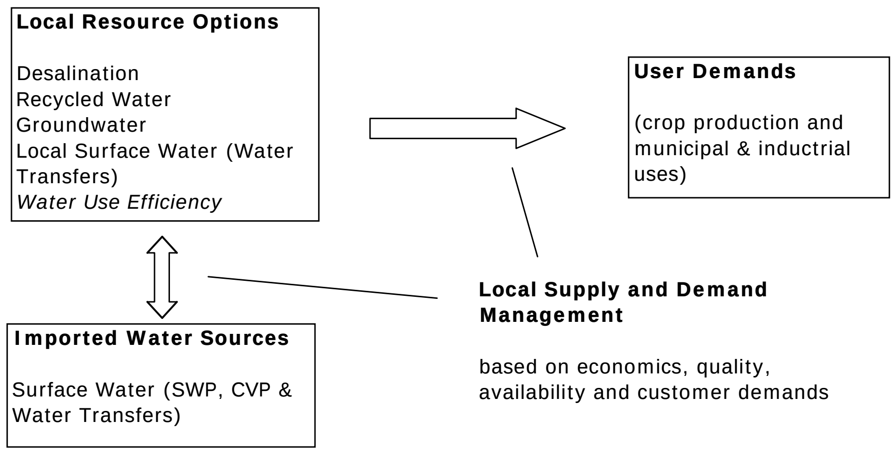

Figure 1. Supply and demand management decision-making process by local and regional water suppliers.

Figure 1 shows the decisions that local and regional water suppliers go through to meet user demands. Demand for a quantity of water is a function of the value placed on that quantity by its users as well as the costs associated with realizing its use. Costs associated with the use of that quantity of water include development, conveyance, distribution, as well as any treatment costs. That quantity will be demanded only if its marginal value exceeds the marginal costs of its use. Subsidies, wholesale and retail pricing policies and rate structures that insulate retail agencies and water users from actual marginal use costs, reduce the likelihood of economically efficient water use decisions.

Reducing the demand on Delta inflows and exports or the demand for additional supply facilities that would affect the Delta can be achieved either by reducing their marginal value to the region or by increasing the costs of their use (or development) relative to regional water efficiency measures. Wholesale or retail water agency-level decisions regarding the use of existing Delta-related storage and conveyance facilities are essentially only influenced by operating costs. Deliveries using those facilities are therefore much less likely to be affected compared to decisions regarding the construction and operation of new facilities.

Regional recycling and efficiency actions that can provide reliability benefits at a lower cost to the user can reduce the demand for water from the Delta. Aside from any associated cost reduction benefits, demand on the Delta can also be reduced by actions that increase the efficiency with which existing supplies are used. While regional recycling avoids supply development and conveyance costs, user-level water use efficiency actions avoid these costs as well as treatment and distribution costs compared to a Delta supply.

Evaluating the overall value of recycling or water use efficiency actions compared to a Delta supply involves accounting for how the actions would affect reuse, carryover storage, and water quality. Evaluation also involves how conservation actions would affect water system reliability. Recycling or long-term conservation actions generally have a constant impact on demand, storage projects—including conjunctive use —can be operated to provide water for use only when it would have its highest economic value for reducing the costs and losses associated with shortage events.

Supply and demand comparison is not straightforward with a complex water management system. Efficiency increases or recycling, when not being exclusively used to manage current use, can allow water supply system managers to increase the amount of carryover in existing storage facilities in order to meet future shortage events, thus reducing the need for imported supplies for that purpose.

> **Demand Hardening**
>
> Most water use efficiency programs rely on plumbing and appliance retrofits and changes in the consumer's water use that can take place on a consistent, predictable basis. Once most of these retrofits have been completed, some worry that their ability to further reduce water use during dry years will be limited. This phenomenon is known as "demand hardening". This is only a portion of the picture.

> When water is used, some of it is removed from the system through evaporation, plant use or outflow to the ocean or other saline sink, this portion is **consumptive use** and is considered **irrecoverable water**. The portion of water that returns to the system is the **recoverable water -** this portion is available for other uses.

Delta connections. The Delta impacts water use efficiency in several ways. The Delta connection in agricultural water use efficiency is both direct and indirect. The direct connection is in the reduction of irrecoverable flows - this translates to a reduced demand on Delta inflows and exports either now or in the future. The indirect connection to the Delta from agricultural water use efficiency is through up-stream actions that either increase the quantity of in-stream flows (recoverable water), improve the quality of water or both. Additional in-stream flows and water quality benefits improves the aquatic habitat and therefore improves the overall ecosystem.

Another way that the Delta impacts water use efficiency is through water quality. Similar to the amount of water used, water quality becomes a factor in deciding what sources of water to use - especially for urban water suppliers. Local agencies typically configure treatment facilities to accommodate a historic range of water quality parameters therefore they must balance their source water with their treatment infrastructure and customer expectations.

Timing of water availability from the Delta is a far more critical issue for Delta diverters and for the agricultural water users that are highly dependent on the Delta for their supply. Urban agencies, particularly over the last ten years, have invested in local surface and groundwater storage. The impact of these actions is that they can smooth out the year-to-year hydrologic and regulatory variation in Delta water supplies that are manifested at the export facilities. For the in-Delta users there is much less storage and fewer supply options – therefore these users are more dependent on the Delta as a source of supply.

Section 4. Implementation of Water use efficiency Actions

Service characteristics of agricultural and urban water suppliers. There is a significant difference in the type of delivery service that is needed by agricultural and urban water users and this affects how a water supplier operates, including the implementation of water use efficiency actions and programs. The objective of agricultural water users is to produce food and fiber subject to market forces and environmental variables. Municipal water users are two basic groups – industrial and residential both of which have fairly define demand patterns that are fairly constant from year to year.

Since the characteristics and the objectives differ between urban and agricultural water suppliers it is reasonable to expect that implementation of water use efficiency differs. Table 1 highlights how the service needs differ between agricultural and urban water users.

Table 1. Comparison of agricultural and urban delivery systems.

Characteristics	Agricultural	Urban Residential
Demand Patterns	Serve peak crop ET and typical losses; deliver to 5% to 15% of customers at a time	Ability to serve peak demand and meet fire hydrant flow and pressure standards; could serve virtually all customers at once
System Hardware	Mostly open channel, gravity flow; unexpected changes in deliveries can result in canal spills	Piped and pressurized systems; pipes flow full
Delivery Frequency	Deliveries arranged in advance or on fixed schedule (rotation) - two to six weeks between deliveries	Deliveries available on demand
Delivery Rate	0.5 to 20 cfs (225 to 9,000 gpm)	0.5 gpm to 20 gpm
Delivery Duration	2 to 72 hours	continuous
Water Quality	Untreated, contains debris	Treated to potable standards
On-Site Storage	Root zone stores crop demand for 2 to 6 weeks	None

Context Memorandum: Demand Management (Water Efficiency)

Iteration 2: July 9, 2007

A common approach to urban water use efficiency is to implement best management practices. Best management practices are a specific list of actions that are known to achieve water use efficiency benefits. The installation of low-flow-shower heads is an example of an urban best management practice. Through a review of urban water management plans, the State monitors the implementation of best management practices. A voluntary memorandum of understanding between urban water suppliers and the California Urban Water Management Council identifies actions that local suppliers agree to implement. An important program underpinning is to get local agencies to implement BMP and other cost-effective conservation practices.

Urban BMPs

BMP 1: Residential Survey Programs

BMP 2: Residential Plumbing Retrofit

BMP 3: System Water Audits

BMP 4: Metering w/Commodity Rates

BMP 5 Large Landscape Conservation

BMP 6: High Efficiency Clothes Washers

BMP 7: Public Information Programs

BMP 8: School Education Programs

BMP 9: Commercial Industrial Institutional

BMP 10: Wholesaler Agency Assistance Programs

BMP 11: Conservation Pricing

BMP 12: Conservation Coordinator

BMP 13: Water Waste Prohibitions

BMP 14: Residential Ultra Low Flush Toilet Replacement Programs

In some cases urban conservation practices have two components – hardware and behavior modification. Modification of customer behavior and purchasing is sometimes required for an action to be successful. For example, several studies have shown that adjusting run-time for lawn sprinklers can save a significant amount of water without sacrificing the aesthetic qualities of a lawn. However, the savings are dependent on active management or some greater level of control over the sprinkler timer.

Benefits - Cost Standard

From a recent report prepared for the California Urban Water Conservation Council.

> At the heart of the new understanding of water efficiency is an economic standard: a good water use efficiency program produces a level of benefits that exceed the costs required to undertake the program. Water use efficiency programs for which this is not the case are questionable undertakings for water utilities. One of the key challenges lies in the determination of utility benefits from WUE programs…. By analyzing the direct costs that utilities can avoid via demand reduction, water utilities define the benefits produced by conservation programs.

As described above agricultural water suppliers typically have a much greater variation in both the infrastructure and operations compared with urban water suppliers. This variation makes it difficult to implement a standard list of water use efficiency practices. The current approach for agricultural water use efficiency is to use cost-benefit criteria to identify potential projects. For example, eliminating canal spill may cost $45 per acre-foot of saved water whereas the cost of importing water may be $75 per acre-foot therefore, just based on costs this project is justifiable. The CALFED program takes the agricultural water use efficiency one step further by pursuing statewide benefits from the implementation of local water use efficiency actions. For example, if a river reach needs additional in-stream flow needs, the CALFED program is willing to pay for the portion of the costs that are not locally cost-effective.

Section 5. Status and Potential of Water Use Efficiency

The information presented in this section is taken from the CALFED Program's evaluation of the first four years of its implementation of the water use efficiency element, a component CALFED's water supply reliability objective. The Comprehensive Evaluation looked at the progress to date in implementing agricultural and urban water use efficiency as well as recycling and desalination. In addition, the evaluation modeled the potential for additional agricultural and urban water use efficiency and discussed the possible range of recycling and desalination.

In reviewing this report, readers need to be aware that the Comprehensive Evaluation was constrained by significant data limitations. For example, there is no comprehensive data related to locally funded actions within the agricultural, desalination and recycling components; only on the urban side is there an extensive database that collects voluntarily reported savings associated with local water use efficiency actions. Similarly, expected benefits associated with grant-funded projects reflect local agency proposed (grant application based) savings; the figures do not represent observed savings. This data gap represents a serious challenge to agencies and stakeholder communities committed to developing a well-informed water management strategy.

Still, there are important findings to be considered. The Comprehensive Evaluation suggests the following crosscutting findings:

- Projections strongly support the position that aggressive investment in water use efficiency actions can results in significant reductions in applied water use over the next 25 years. Depending on the level of investment and other policies, the analysis projects savings of 1.4 to 3.1 million-acre feet by 2030: 180,000 to 1.1 million acre-feet for the agricultural sector; and 1.2 million to 2.1 million acre-feet from urban. Additionally, there is very large potential from both desalination and recycling.

- There is solid demand at the local level for state and federal water use efficiency grants. Over the past four years, 235 grants totaling $305 million have been awarded across all four components. The demand for grant funding has repeatedly outstripped the available funds. In the urban sector alone, funding requests from urban water suppliers have exceeded available state and federal funds by a roughly eight-to-one ratio; agricultural requests were double the available funding.

- An analysis of savings over the first seven years (Stage 1) offers a mixed picture. (See table below.) Agricultural and urban water use efficiency show the potential to generate substantial water savings at average costs ranging from $25 to $340 per acre foot, but the overall savings are likely to fall far short of both ROD and Comprehensive Evaluation projections due to three main factors: (1) agricultural and urban grant funding for water use efficiency actions is 80 percent lower than projected in the ROD; (2) key agricultural and urban assurances actions anticipated in the ROD are not yet implemented; and, (3) local efficiency actions are either below projected levels or there is insufficient data to measure progress. Recycling is anticipated to exceed ROD projections, but the cost – $800 per acre-foot on average – is significantly higher than savings generated through agricultural or urban water use efficiency actions. Savings generated through desalination are, also expensive relative to other efficiency options averaged $957 per acre-foot.

Table 2. CALFED Program Stage 1 Water Savings: Projected and Expected

		ROD Projections	Comp Evaluation Modeling	Expected Savings	Projected Yearly Average Cost Per Acre-Foot of Savings (based on recent grant-funded projects)
Ag[1]	Lower Bound	260,000 AF	180,000 AF	50,000 AF	$28/AF for in-stream savings; $350/AF for supply reliability savings[2]
	Upper Bound	350,000 AF	250,000 AF	50,000 AF	
Urban	Lower Bound	520,000 AF	267,000 AF	101,000 AF	$160 to $340/AF
	Upper Bound	680,000 AF	356,000 AF	142,000 AF	
Recycling	Lower Bound	225,000 AF	Not Modeled	387,000 AF	$800/AF
	Upper Bound	310,000 AF	Not Modeled	510,000 AF	
Desal	Lower Bound	Not Modeled	Not Modeled	20,000 AF (no range)	$957 per acre foot, on average; range from $430 to $1,387
	Upper Bound		Not Modeled		

- Although grant-funded water savings account for only a small percentage of total savings potential, they leverage significant additional local investment, act as an investment catalyst, help to promote regional partnerships and joint ventures, and increase the geographic base of implementation.

- Sufficient project-level baseline data or observed project cost and performance data have not been collected. Therefore, an understanding of progress toward meeting ecosystem restoration, water quality and water supply reliability objectives is not possible. In addition, the lack of project- program-level data severely limits the use of adaptive management for program improvement.

The recommendations – described in greater detail in the full report – fall into four main categories:

- *Program Structure/Assurances.* The Comprehensive Evaluation suggests program implementers should consider three specific recommendations related to program structure and assurances. They are: (1) assess the viability of the grant-driven

[1] The agricultural efficiency figures include the savings and costs associated with both recoverable and irrecoverable savings.

[2] The range of per-acre foot average costs associated with agricultural savings was between $5/AF and $112 for in-stream, savings, and $28 to $515 for water supply reliability savings.

approach given expected state and federal fiscal constraints; (2) determine whether to implement a process to certify compliance with the Urban Memorandum of Understanding; and, (3) revisit the effectiveness of the Quantifiable Objectives approach and associated assurances.

- *Monitoring Performance.* Data gaps and limited program assessments greatly handicap effective program implementation. To remove this important barrier, Program implementers are encouraged to consider the following: (1) develop and track specific performance measures for the Water Use Efficiency Program; (2) where fiscally feasible, move forward with the broadly supported package of administrative and legislative water use measurement actions; (3) improve collection of data on locally funded actions; and, (4) revise the grant process to more closely monitor, verify and track results.

- *Financial Assistance Program.* A review of water use efficiency financial assistance programs suggests that there is insufficient information to determine the extent to which current grant and loan programs are supporting WUE Program objectives. Based on the Comprehensive Evaluation findings, implementation agencies are encouraged to (1) revisit grant program structure and protocols, and (2) determine the need, efficacy and structure of urban and agricultural loan programs.

- *Technical Assistance and Research.* The Comprehensive Evaluation suggests that both technical assistance and research efforts to-date have consisted of a patchwork of initiatives. Agency implementers are encouraged to consider the following recommendations related to these important tasks: (1) evaluate research funded activities to-date, identify research priorities for the next program stage, and establish protocols to disseminate research findings and (2) conduct a market assessment to determine the appropriate structure and scope of technical assistance programs and develop a strategic plan for implementation.

"Look-forward" Projections. The aim of the Authority's "look-forward" effort is to answer the question: What is the potential of water use efficiency actions statewide given different levels of investment and policies? In other words, the Water Use Efficiency Element is striving to develop a range of projections that reasonably bracket potential water use efficiency savings over the next 25 years or so. To generate a "reasonable bracket" of water use efficiency projections, the evaluation undertakes a series of analyses that assume differing levels of investments and different policy actions.

Agricultural Projections. The Comprehensive Evaluation's six projections of agricultural water use efficiency potential strongly support the position that aggressive investment in agricultural water use efficiency can result in significant reductions in irrecoverable flows (flows to saline sinks and non-beneficial ET) and recoverable flows (in-stream flow and timing changes primarily achieved through changes to diversions, return flows and seepage) through 2030.

Water use efficiency potential for the projections are given in the table below The results of the projections analysis indicate the following:

- Agricultural water use efficiency actions for projection levels 1, 3 and 5 can generate between 184,000 and 1,137,000 acre-feet of recoverable and irrecoverable water by 2030.
- Application of regulated deficit irrigation techniques on amenable crops is projected to yield approximately 142,000 acre-feet of reductions in non-productive ET. This water is then available for other beneficial uses such as transfers or consumptive use.

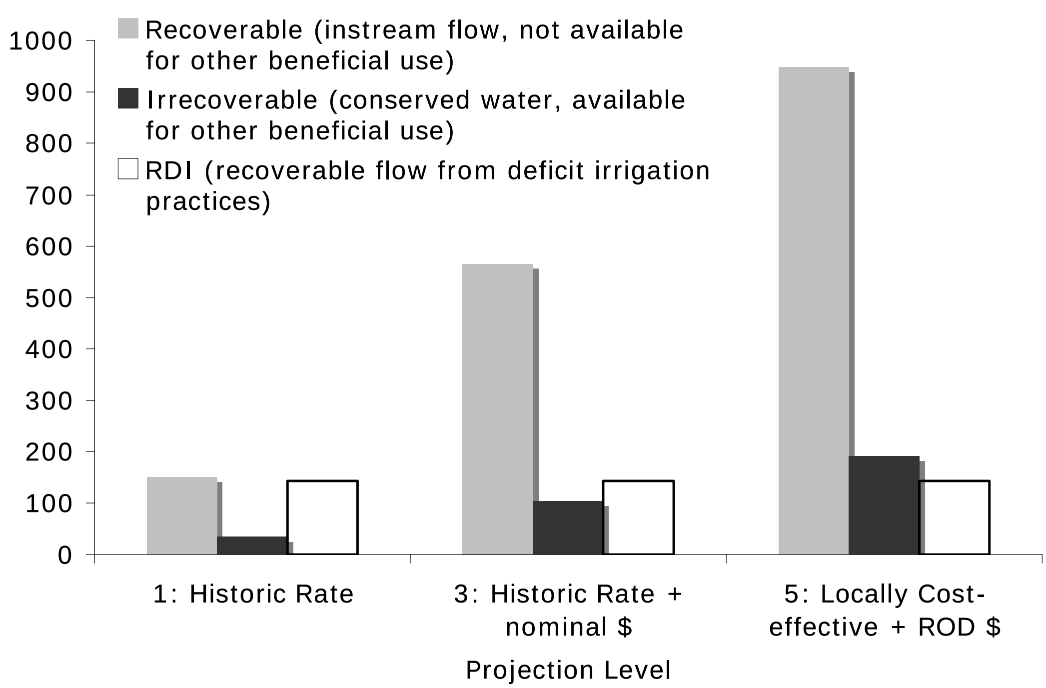

Figure 2.Estimates of 2030 combined on-farm and district agricultural water use efficiency potential. Historic rate is based on projecting the historic rate of implementation of water use efficiency actions into the future. Nominal dollars refers to a funding level through 2030 that is equivalent of CALFED program expenditures during 2000-2007.

- All projection levels show potential to meet a portion or all of the in-stream flow needs identified in the Targeted Benefits (these are specific state needs that can be met through agricultural water use efficiency).

Urban Projections. The Comprehensive Evaluation's six projections of urban savings potential strongly support the position that aggressive investment in urban water use efficiency can result in significant reductions in urban applied water use over the next 25 years. These projections evaluated urban water savings potential from three sources:

- Efficiency codes that require certain water using appliances and fixtures to meet specified levels of efficiency;
- Local implementation of BMPs as well as other locally cost-effective conservation measures; and
- Additional urban conservation measures co-funded through CALFED Agency grant programs.

The first five projections adopted different assumptions regarding state and federal and local investment rates. The sixth projection measured the water savings potential assuming 100% adoption of the measures under evaluation. This last projection served as a reference point from which to evaluate the other five.

Water savings potential for the six projections are shown in the following table. The results of the projections analysis indicate the following:

- Water savings for projections 1 through 5 range between 1.2 million and 2.1 million acre-feet per year by 2030, and capture 39% to 68% of technical potential. The projected range of savings would meet the domestic water demands of 6.3 million to 10.9 million residents at current rates of household water use.
- While California's population is projected to increase 35% by 2030, urban water use would increase by only 12% if California were to realize the upper-end of the range of projected urban water savings (i.e. Projection 5).
- Water savings from local agency implementation are sharply affected by the local investment assumption. Realizing the upper-end of the range of savings potential requires full implementation of locally cost-effective BMPs (Projections 2, 4, and 5). The analysis indicates that historic rates of investment in BMPs would not be adequate to realize the upper-end of the savings range (Projections 1 and 3).

Savings potential assuming implementation of all locally cost-effective measures is approximately five times greater than from assuming the historic rate of BMP implementation.

- Efficiency codes are a significant source of water savings for the urban sector. Codes related to toilet, showerhead, and washer efficiency, as well as codes that require metering customer water connections are essential to realizing the projected water savings potential. Efficiency codes account for 46% to 84% of total savings for projections 1 through 5.

- Although grant funded water savings account for only a small percentage of total savings potential, they leverage significant additional local investment, can act as an investment catalyst, help to promote regional partnerships and joint ventures, and increase the geographic base of implementation.

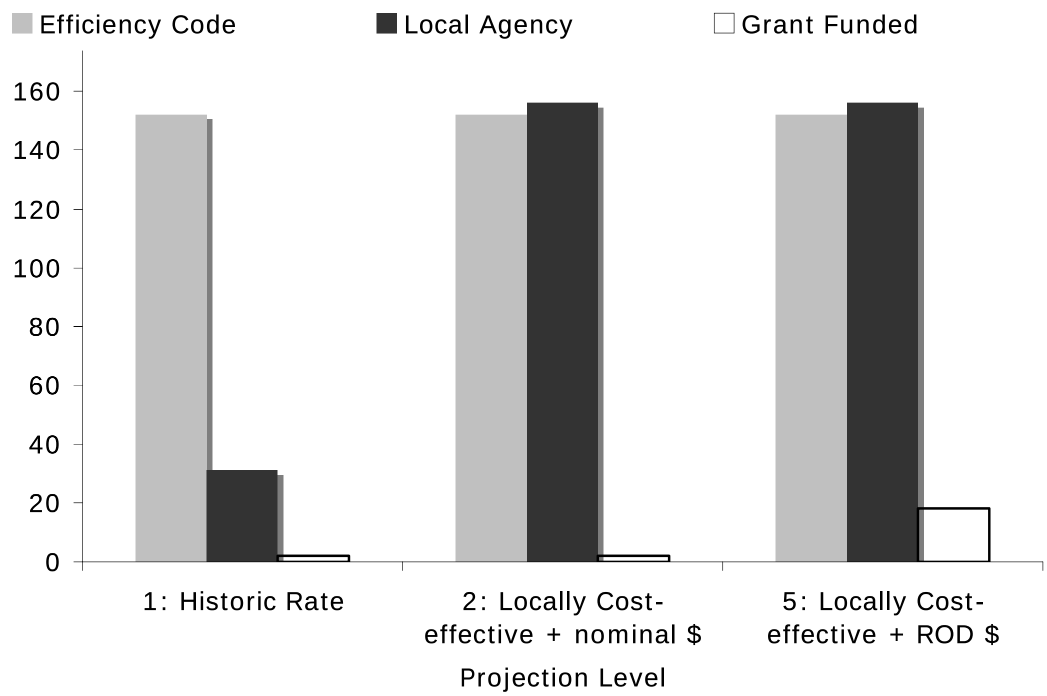

Figure 3. Estimates of 2030 urban conservation savings potential – Bay Area. The locally cost-effective level assumes full implementation of all water use efficiency actions that are define by the BMP's. Nominal dollars refers to a funding level through 2030 that is equivalent of CALFED program expenditures during 2000-2007.

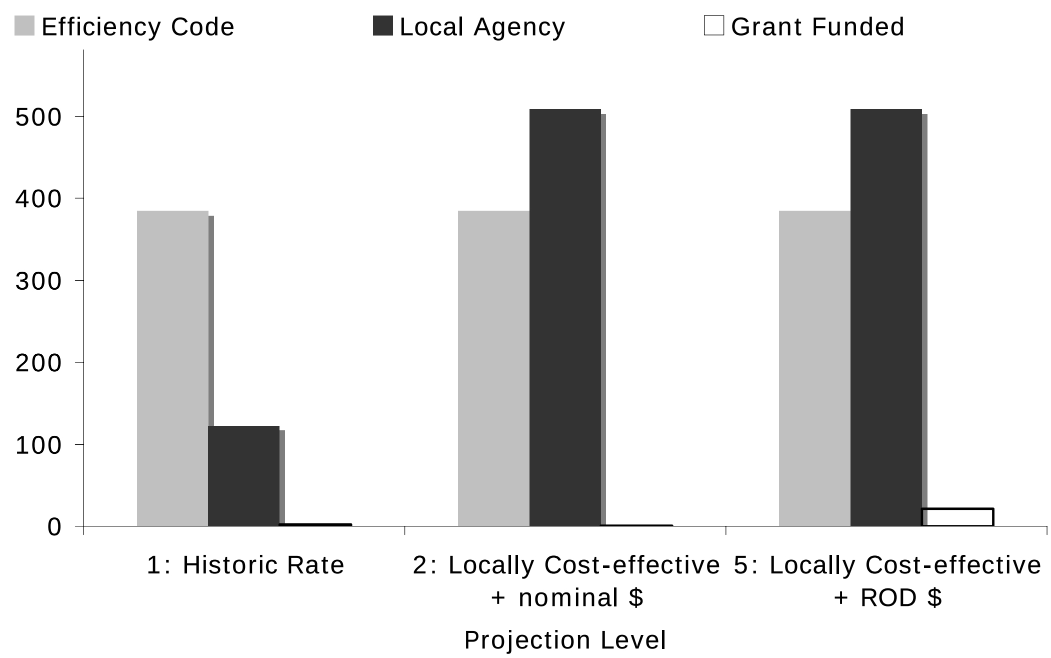

Figure 4. Estimates of 2030 urban conservation savings potential – South Coast. The locally cost-effective level assumes full implementation of all water use efficiency actions that are define by the BMP's. Nominal dollars refers to a funding level through 2030 that is equivalent of CALFED program expenditures during 2000-2007.

Figure 5 shows the *statewide* reduction in applied water use due to efficiency codes and regionally cost-effective conservation investments by type of end use. Residential uses account for 57% of total savings potential while CII and non-residential landscape uses account for the other 43%. Within residential uses, approximately three-fourths of the savings potential comes from indoor water uses and one-fourth from outdoor landscape water uses. Most of the indoor residential water savings are efficiency code-driven savings.

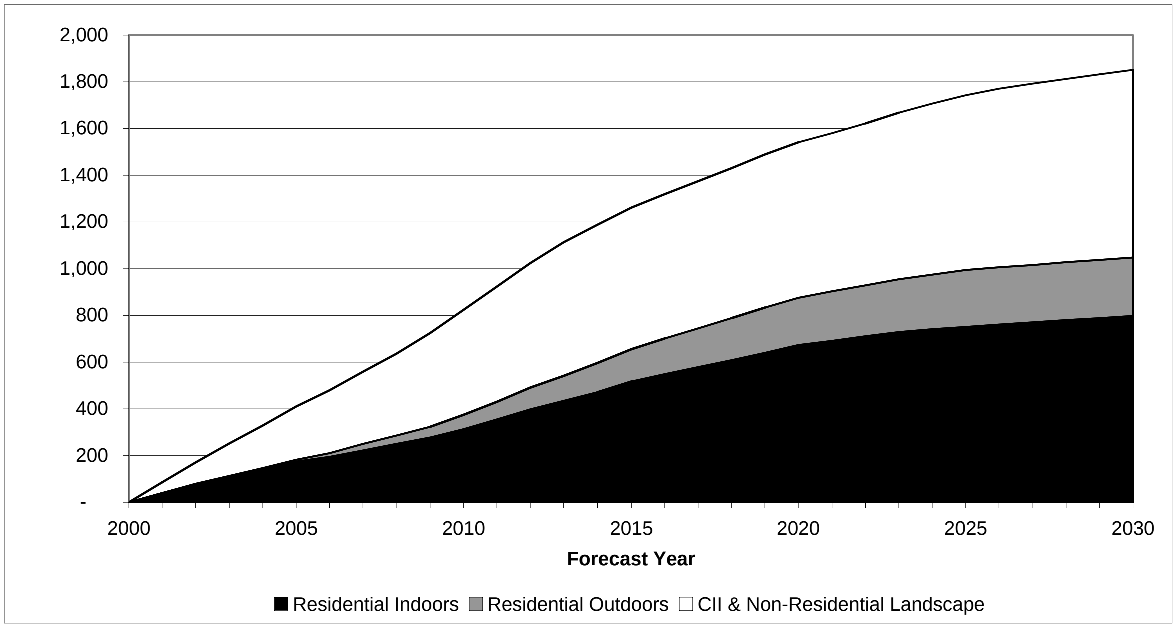

Figure 5. Statewide reduction in urban water use resulting from the implementation of efficiency codes and regionally cost-effective investments.

Section 6. Science and Information

The unknowns in water use efficiency are primarily related to a lack of comprehensive, consistent and timely data and as the scale increases, from local agency to statewide, the lack of consistent and comprehensive data becomes a greater issue. The preparation of the agricultural component of CALFED's Comprehensive Evaluation was severely hampered by a lack of data about the benefits of locally led water use efficiency actions. The urban analysis was more robust because there is relatively good data and information available through the California Urban Water Conservation Council. Analysis of state funded water use efficiency efforts was primarily limited to an analysis of the grant applications. This was necessary because there is no analysis of the benefits generated from the implementation of the CALFED Water Use Efficiency grant program. Data collection and analysis of individual grant funded projects and entire water use efficiency programs would allow for a more informed decision making effort. Ideally, the data and information would be utilized to develop a water management strategy that considers all options on the supply-demand continuum.

Section7. References

To be developed